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ABSTRACT

A 1977-78 survey of bachelor's degree recipients in physics and astronomy investigated graduates' postbaccalaureate plans. Highlights of the findings are: a small shift in postbaccalaureate plans away from graduate study and into employment for both physics and astronomy bachelors; an improved employment outlook for physics graduates with regard to an increase in positions that make extensive use of physics training; and an increase in astronomy bachelors who enter physics graduate study. Data are presented on the following areas: plans of physics bachelor degree recipients, 1969-78; characteristics of physics graduates, 1977-78; postbaccalaureate plans of minority group members among physics bachelors of the class of 1978; sources of anticipated support for first-year graduate study, 1973 and 1978; changes in employment outlook for the new physics bachelor's degree recipients, 1971-78; initial employment of physics graduates with bachelor's degrees, 1972-78; use of physics training by type of employment; full-time employment of new physics bachelor's degree recipients; starting salaries for new physics bachelors; and characteristics of astronomy bachelor's degree recipients, 1978; and use of astronomy education by type of employer for astronomy bachelors, 1978. (SW)

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AIP report MANPOWER STATISTICS DIVISION

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1977–78 SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECIPIENTS

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by Susanne D. Ellis

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The survey of bachelor's degree recipients in physics and astronomy focuses on the graduates' postbaccalaureate plans. Another AIP survey determined the total number of bachelor's degrees granted: 4457 physics degrees and 177 astronomy degrees during the academic year 1977–78. The highlights of this report are:

- a small shift in postbaccalaureate plans away from graduate study and into employment for both physics and astronomy bachelors
- an improved employment outlook for physics graduates with regard to an increase in positions that make extensive use of physics training
- an increase in astronomy bachelors who enter physics graduate study

Figure I shows the changes in the four major postbaccalaureate plans since 1969 when the largest number of physics bachelor's degrees was granted. The greatest change over this ten-year period is in the proportion of graduates who choose "other graduate study" which ranges from 18% to 28%. Only a small proportion of the graduates who report "other graduate study" enter a discipline that is unrelated to physics. Table I presents the numerical data on which Figure I is based and also includes a small group of graduates who are undecided about their postbaccalaureate plans. The last line of Table I is taken from the Survey of Enrollments and Degrees which determines the total number of physics bachelor's degrees granted in the United States.

Fig. I. Trend in postbaccalaureate plans of physics bachelors, 1968–78

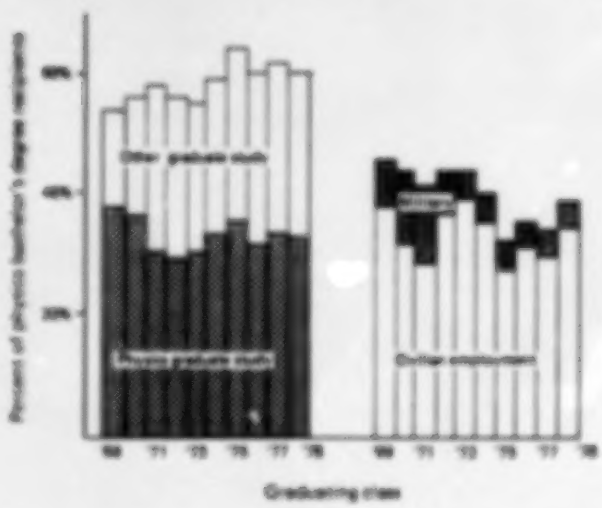

Table I. Postbaccalaureate plans of successive graduating classes of physics bachelors, 1968–1978.

Postbaccalaureate plans	Graduating Class 1968–69	1969–70	1970–71	1971–72	1972–73	1973–74	1974–75	1975–76	1976–77	1977–78
Physics graduate study	38%	37%	31%	30%	31%	34%	36%	32%	34%	33%
Other graduate study	18	19	26	28	24	25	27	28	28	28
Civilian employment	36	32	29	37	39	36	28	31	30	34
Military service	8	12	12	7	5	4	4	4	4	5
Undecided	–	–	2	–	1	1	5	5	4	2
Total number of physics bachelor's degrees	5870	5782	5768	3282	4823	4652	4571	4487	4517	4457

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Table II. Characteristics of physics bachelor's degree recipients, 1977-78

Characteristics	Postbaccalaureate plans: Graduate study physics	Graduate study other	Employment	Undecided	Total
Sex					
Female	8%	11%	14%	13%	11.8%
Male	92	89	86	87	88.4
Citizenship					
U.S.	95%	94%	98%	98%	96.1%
Foreign	5	6	2	2	3.9
Age					
20 or younger	2%	1%	1%	–	1.1%
21	8	8	3	3%	6.2
22	53	53	41	31	47.8
23	19	21	22	21	21.0
24-25	16	15	26	33	19.9
26 and older	1	2	7	2	4.0
Minority group					
Black	1.2%	1.4%	1.6%	–	1.4%
Mexican American	0.4	0.3	0.2	1.8%	0.3
Other Spanish	1.1	–	0.6	–	0.6
American Indian	0.1	0.3	0.4	–	0.3
Asian Indian	0.4	0.3	0.1	–	0.2
Oriental	3.7	4.4	0.9	3.3	2.9
Arab	0.3	1.3	2	1.8	0.5
Type of high school physics					
PSSC	30%	31%	28%	28%	29.2%
Project physics	10	14	12	6	11.7
Other	47	42	43	46	44.2
None	13	13	17	19	14.9
Type of undergraduate institution					
PhD-granting	60%	46%	43%	46%	49.8%
MS-granting	15	11	16	11	14.3
BS/BA-granting	25	43	41	43	35.9
Total number of bachelors	1471	1159	1738	89	4457
% distribution	33%	26%	39%	2%	100%
Number of respondents	825	641	975	60	2501

Table II presents six characteristics of the physics graduating class of 1978. While certain characteristics do not change significantly from year to year, others like age at graduation and high school physics show marked changes. For example, ten years ago only 5% of the graduating physics bachelors had not studied physics in high school; for the class of 1978 this percentage is 15. Also, the median age of physics bachelor's degree recipients is gradually rising. 30% of the class of 1968 was 23 years or older. In the class of 1978, 45% of the graduates are 23 or older, and for those who plan immediate employment, it is 58% who fall into that age group.

Despite the current emphasis on science and science degrees, almost one third of the physics bachelors are granted bachelor of arts degrees. Table III relates the science or arts degrees to the type of institution, and shows that students at the 4-year colleges are divided almost evenly between arts and science degrees. The two types of graduate institutions on the other hand confer science to arts degrees at a 3:1 and 6:1 ratio.

Table III. A science or arts degree granted in physics to physics bachelors by type of institution, 1977-78.

Type of institution	Bachelor of Science	Bachelor of Arts	Total N	%
PhD-granting	1641	577	2218	49.8
Master's-granting	508	84	590	13.2
Bachelor's-granting	916	733	1649	37.0
Total bachelor's degrees	3063 68.7%	1394 31.3%	4457	100.0%

Table IV. Postbaccalaureate plans of the members of minority groups among the physics bachelors of the class of 1978

Minority group:	Black	Mexican American	Other Spanish	American Indian	Asian Indian	Oriental U.S.	Oriental Foreign	Arab
Graduate study in physics	10	3	9	1	3	18	12	3
Other graduate study	9	2	–	2	2	14	14	9
Engineering	7	–	–	–	1	3	4	6
Medicine or biophysics	1	–	–	–	–	2	1	–
Mathematics	–	–	–	–	1	1	2	–
Other science	1	2	–	1	–	6	5	1
Other	–	–	–	1	–	1	2	1
Employment	15	2	6	4	1	6	3	2
Number of job offers: 0	2	–	–	–	–	–	1	1
1	7	1	2	2	–	3	2	1
2	3	–	3	–	–	1	–	–
≥3	3	1	1	2	1	2	–	–
Total in survey:	34	7	15	7	6	38	29	13

The first part of the questionnaire sent to each degree recipient deals with background characteristics one of which is a listing of six distinct minority groups. In the 1978 survey 8% of the 2501 respondents identified themselves as members of a minority group, including 13 Arabs who specified their group under "other".

The postbaccalaureate plans of minorities are different from those of all physics bachelors; 74% plan to enter graduate schools, and only 26% are interested in immediate employment. The reason for the large proportion of minorities interested in graduate study is that almost half of them are foreign citizens and presumably on a student visa in the United States. Details of the plans of each group are shown in Table IV.

There were few changes in the distribution of sources of support for beginning graduate students in the five year period from 1973 to 1978. As more teaching assistantships for physics students and research assistantships for other graduate students became available, off-campus employment as well as other sources of support appeared to decline.

Table V also points out the differences in sources of support offered to first-year graduate physics students and those beginning graduate study in other disciplines. Only 3% of the former group needed to depend on family funds, savings or loans while 23% of those interested in "other graduate study" expected to support themselves through those means. Also assistantships were offered to the two groups of graduate students in very different proportions: 79% of the graduate physics students, compared with 47% of those intending "other graduate study" reported that source of support. Very few in either group of graduate students plan to study on a part-time basis, and a high proportion of each group is assured of the reported sources of support.

Table V. Sources of anticipated support for first-year graduate study*, 1973 and 1978.

Sources of support		Students planning: physics graduate study		other graduate study	
		1973	1978	1973	1978
Teaching assistantship		57%	67%	22%	23%
Research assistantship		12	12	15	24
Fellowship		12	13	17	13
Employment		8	3	15	11
Family, savings, loan		4	3	19	23
GI Bill		1	1	3	1
Other		6	1	9	5
Assured		86%	92%	73%	79%
Intended		14	10	27	24
Graduate study status	full-time	97%	98%	97%	96%
	part-time	3	2	3	4
Total	%	100%	100%	100%	100%
	N	1650	1471	1300	1150

*The information was reported as of September of each academic year.

Fig. II. Postbaccalaureate plans of the class of 1978

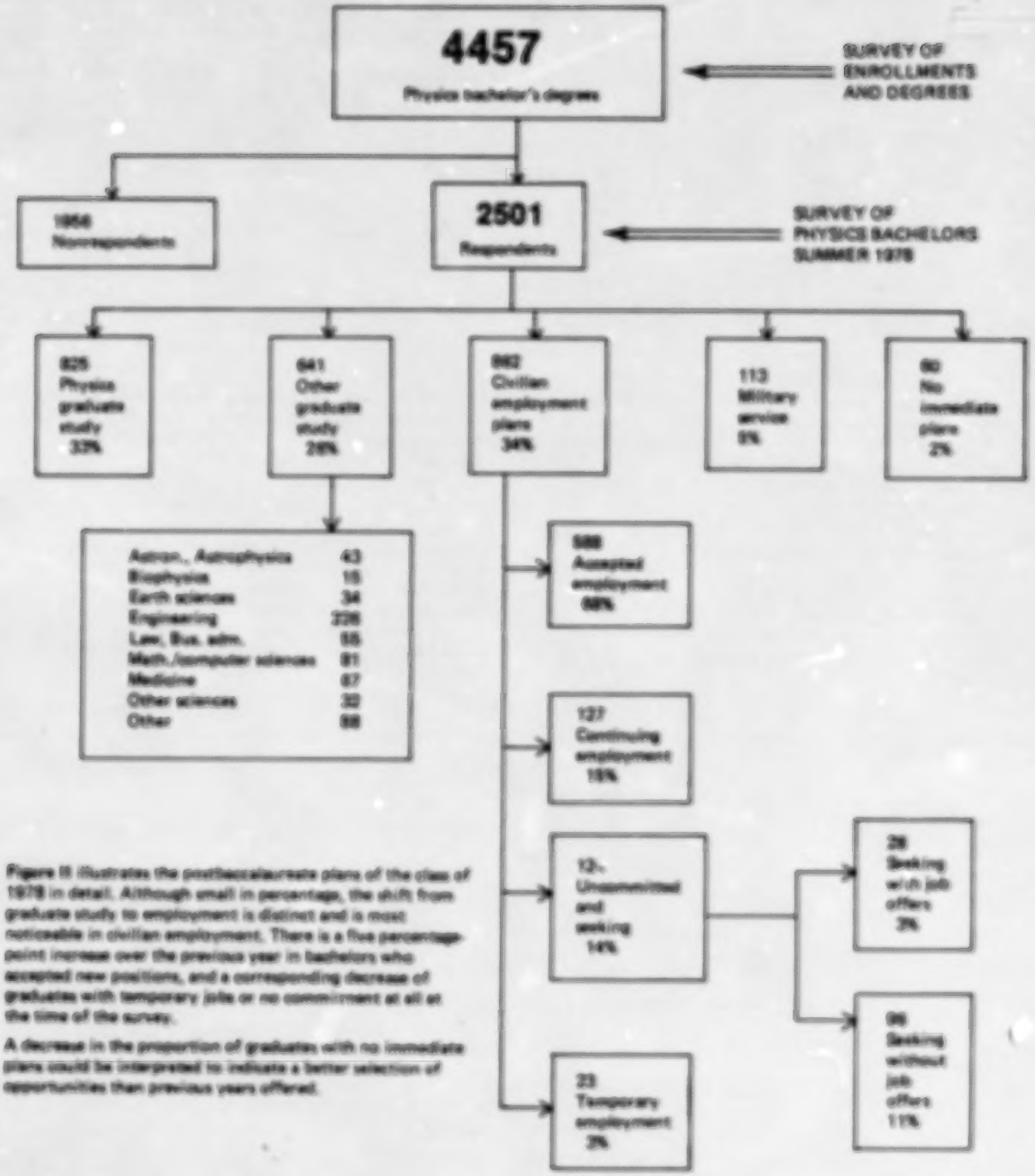
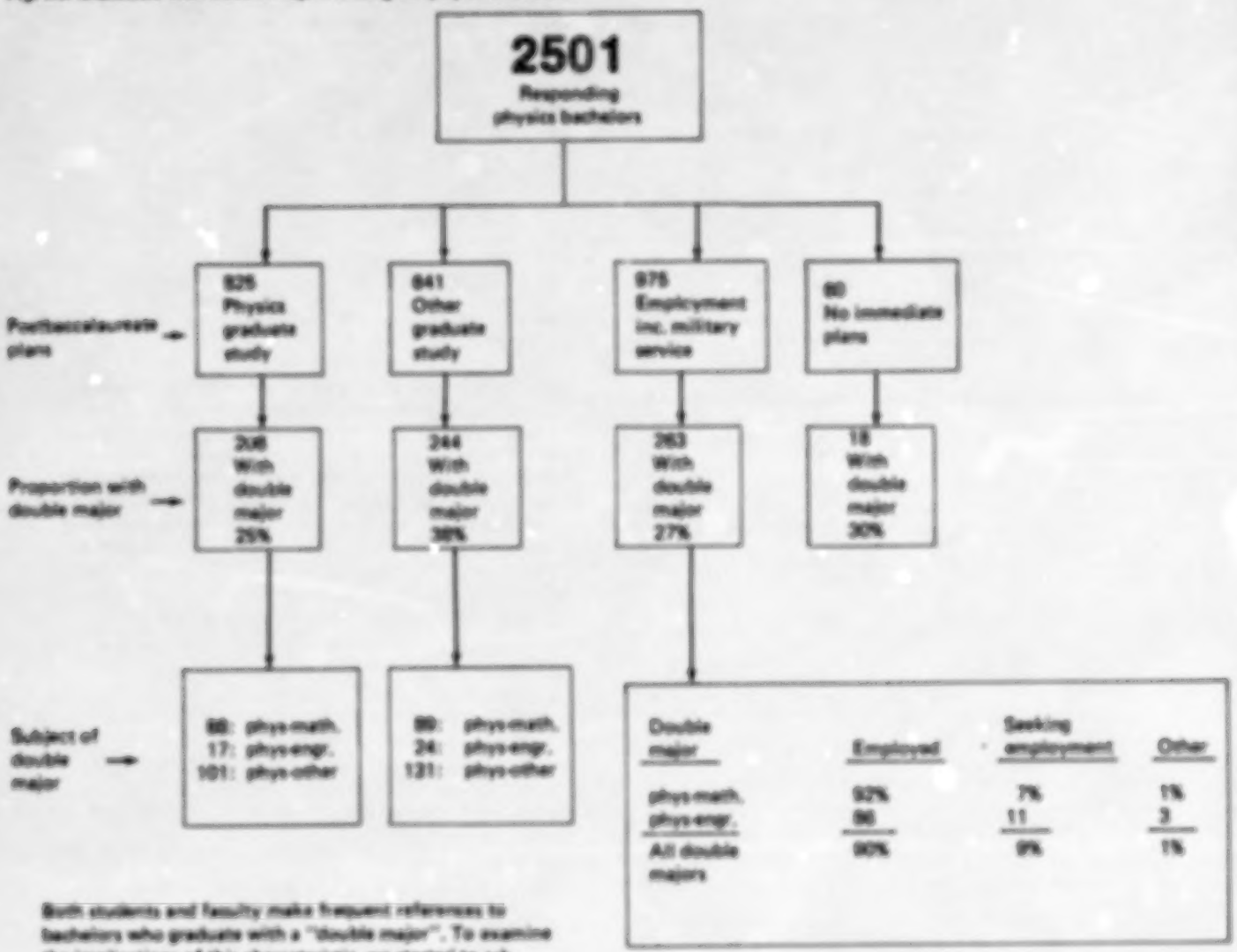


Figure II illustrates the postbaccalaureate plans of the class of 1978 in detail. Although small in percentage, the shift from graduate study to employment is distinct and is most noticeable in civilian employment. There is a five percentage-point increase over the previous year in bachelors who accepted new positions, and a corresponding decrease of graduates with temporary jobs or no commitment at all at the time of the survey.

A decrease in the proportion of graduates with no immediate plans could be interpreted to indicate a better selection of opportunities than previous years offered.

Fig. III. Graduates with double majors among the physics bachelors



Both students and faculty make frequent references to bachelors who graduate with a "double major". To examine the implications of this characteristic, we started to ask graduates to comment on that choice and specify the second major. Almost 30% of the respondents reported a double major. Figure III specifies the most frequently chosen combinations of majors and indicates what proportion of graduates within each postbaccalaureate plan chose a double major. As expected, the group interested in nonphysics graduate study has the highest proportion of graduates with double majors, and many of them choose that second major as their field of graduate study.

An analysis of the employment-oriented graduates with double majors shows that only 9% of them were unable to secure immediate employment, a percentage that compares with 12% for the group that reports no double major.

The steady improvement in employment opportunities for successive graduating classes since 1971 is shown by Table VI both in terms of a declining percentage of graduates with zero job offers and an increasing percentage with multiple offers. The reason for the one percentage point discrepancy between Figure II and Table VI in graduates with zero job offers is that the base in Table VI includes bachelors who entered the military service, while Figure II does not.

Table VI. Changes in employment outlook for the new physics bachelor's degree recipients, 1971-78.

Number of job offers at graduation	Summer 1971	Summer 1972	Summer 1973	Summer 1974	Summer 1975*	Summer 1976*	Summer 1977	Summer 1978
0	48%	41%	26%	18%	17%	17%	11%	10%
1	39	42	50	50	56	53	52	46
2 or more	12	17	24	32	27	30	37	46

*These figures have been revised from those presented in earlier reports to include military commitments.

Table VII. Initial employment of physics graduates with bachelor's degrees, 1973-78

Type of employer	Percentage of employed bachelors					
	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Industry manufacture	31%	33%	29%	30%	32%	37%
Industry service	23	22	25	19	18	21
High school	13	10	11	11	8	7
College or univ.	8	4	5	4	5	3
Government civilian employ.	6	10	9	10	7	7
Government career military	13	10	16	13	12	14
Res. institutes	3	5	4	3	7	7
Other	6	7	5	10	13	4
Total	100%	100%	100%	100%	100%	100%

Table VIII. Use of physics training by type of employment, physics bachelors, 1978

Newly accepted positions with selected types of employers	Use of physics training			Number reporting
	Extensive	Little	None	
Secondary schools	70%	25%	5%	40
Industry-manufacture	51	44	5	260
Industry-service	36	53	11	135
Govt., Peace Corps	55	38	7	42
Research institutes	57	41	2	44
Continuing employment with selected types of employers				
Industry	27%	58%	15%	71
All employers (newly accepted positions)	49%	43%	8%	570
Selected work activities in newly accepted positions				
Science teaching	79%	18%	3%	60
Research & Development	80	19	1	135
Engineering	48	48	2	105
Computer programming	18	58	24	79
Skilled work	14	72	14	14
Nonphysics professional	4	71	25	28

The major change observable in Table VII is the increase in the proportion of graduates who accepted industrial employment. There are two categories of industrial positions for bachelors: one is designated "manufacture" and the other "service". In this manner one can distinguish between positions that utilize more heavily the graduates' physics training, and those that require primarily a college degree or the ability to deal with numbers; banks and insurance companies are examples of "service industries" and included in Table VII. Both industrial categories show increases from the previous year while high school teaching positions continue their decline.

A measure of the quality of the job market is the extent to which a graduate's initial employment utilizes his or her physics training. Table VIII addresses itself to that topic and shows an 8 percentage-point increase over the previous year's graduates who reported making extensive use of their physics training. At the same time the proportion of bachelors who answered "none" to the question of making use of one's physics training, decreased from 14% to 8%. Table VIII also shows a considerable degree of variation in use of physics training between employers and work activities.

The work activities presented in Table IX show very few changes from the year before: nonphysics professional work and skilled work decreased by 3 and 4 percentage points respectively.

Table IX. Full-time employment* of new physics bachelor's degree recipients, 1978

Work activity		Type of employer						Total	
		Industry manufacture	Industry service	High school	Government civilian employment	Government military service	Other incl. self-emp.	N	%
Teaching		–	4	48	6	2	9	69	9
Research & development		84	18	–	15	18	49	180	23
Engineering		141	60	–	12	26	11	248	31
Computer programming		30	40	2	8	4	13	98	12
Nonphysics professional		9	14	–	4	29	7	63	8
Skilled		14	4	–	4	8	3	33	4
Unskilled		2	11	–	1	–	7	21	3
Other		14	16	2	4	31	13	80	10
Total	N	294	168	53	55	119	111	792**	
	%	37	21	7	7	14	14		100%

* The employment of these 793 graduates includes both newly accepted positions as well as those in which graduates are continuing.

** An additional 38 bachelors were employed but did not report their work activities and are consequently not included in Table IX.

Table X. Starting salaries for new physics bachelors, 1978.

Type of employer	Men (581 reported salaries)		Women (58 reported salaries)		Total (647 reported salaries)	
	Distr. by employer	Median monthly salary	Distr. by employer	Median monthly salary	Distr. by employer	Median monthly salary
Industry—manufacture	38%	$1260	35%	$1260	38%	$1260
Industry—service	20	1240	22	1200	20	1230
High school	6	870	17	750	7	830
College or university	4	940	4	*	4	900
Government civilian	9	1035	9	1080	9	1030
Government military	19	970	-	-	18	970
Research institute	6	1210	11	1100	6	1180
Other	2	960	6	*	4	1120
Total	100%	$1157	100%	$1165	100%	$1158

*Insufficient data

With the amount of attention focused on inflation lately salary information is in great demand. Table X lists the median monthly salaries offered by five types of employers to men and women. For all employers combined the median salary increased 11% over the previous year. A higher proportion of women than men accepted high school teaching positions for which the salaries increased only 8% since 1977. Ten years ago we started to publish separate salary information for men and women graduates with physics bachelor's degrees, and the class of 1978 is the first group where women show a higher median salary. Were one to exclude the military, then the median salary paid by civilian employers to male graduates would be $1220.00 or 1 therefore greater than that paid to women.

The comparable median starting salary for chemistry graduates is $1080.00 and therefore almost 9% lower than that paid to physics graduates employed full-time.

ASTRONOMY

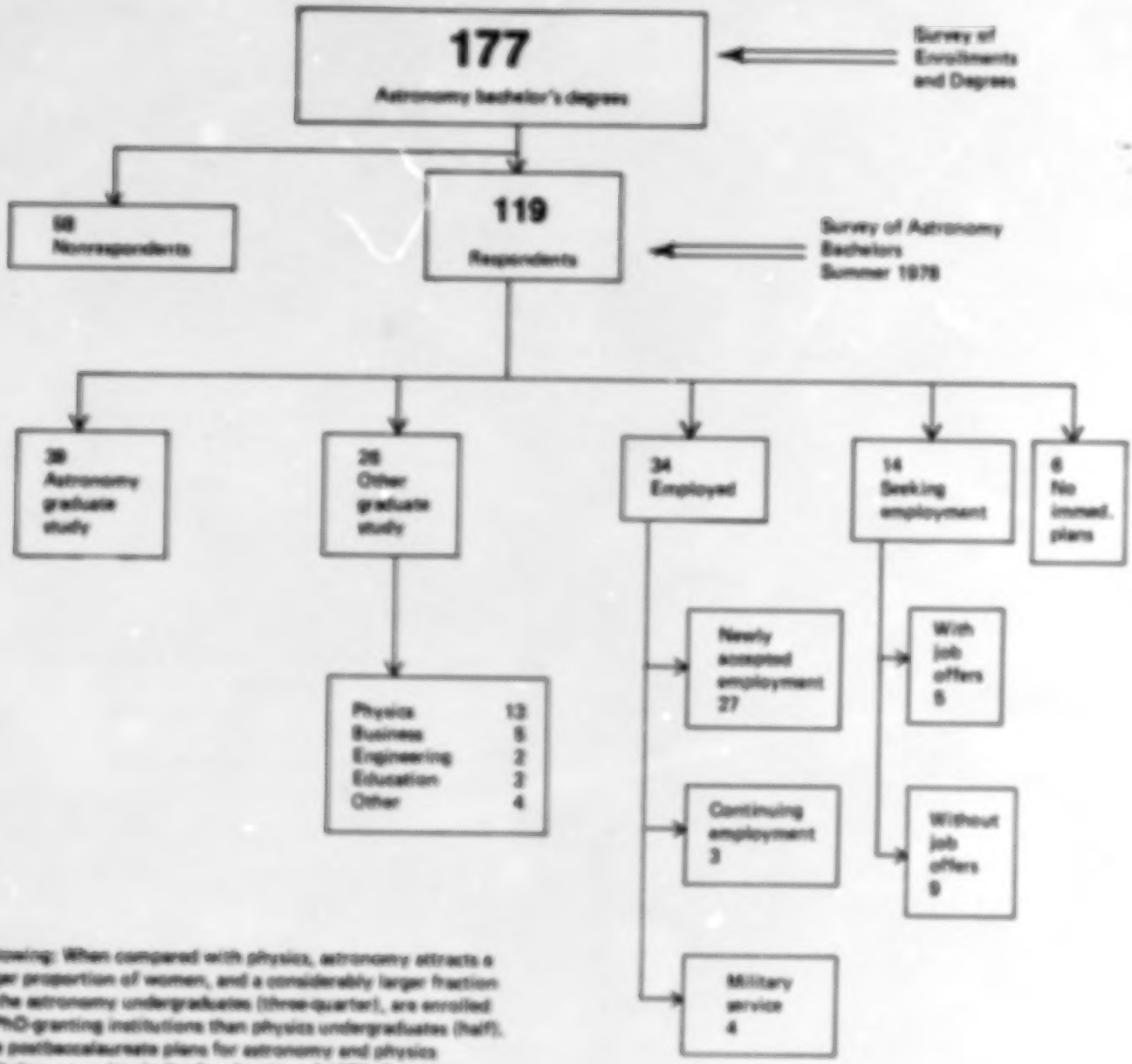
Although it is only the fourth consecutive year in which astronomy graduates participated in our annual survey of bachelor's degree recipients, their response rate is considerably higher than that of the physics graduates. From the Survey of Enrollments and Degrees we know that 177 astronomy bachelor's degrees were granted in 1977–78 and more than 67% of the graduates contributed information regarding their postbaccalaureate plans to this survey.

Table XI divides the respondents into four groups according to postbaccalaureate plan and analyzes six characteristics on that basis. Noteworthy among those characteristics are the

Table XI. Characteristics of astronomy bachelor's degree recipients, 1978

Characteristics		Postbaccalaureate plans: Astronomy graduate study	Other graduate study	Employment plans	Undecided	Total N	Total %
Sex	Female	5	2	11	-	18	16
	Male	34	23	37	6	100	84
Citizenship	U.S.	38	24	47	5	114	96
	Foreign	1	2	1	1	5	4
Type of high school physics	PSSC	15	7	15	1	38	32
	Project physics	6	4	5	-	15	13
	Other	12	13	18	5	19	41
	None	6	2	9	-	17	14
Age	21 or younger	3	-	-	-	3	2
	22	23	17	23	1	62	52
	23–25	14	9	23	3	45	38
	26 or older	-	4	3	2	9	8
Type of degree	BA	14	7	14	4	39	33
	BS	25	18	34	2	80	67
Type of bachelor's institution	PhD-granting	31	22	34	5	92	77
	MS-granting	2	-	6	1	9	8
	BA/BS-granting	6	4	8	-	18	15
Total	N	39	26	48	6	119	
	%	33	22	40	5		100%

Fig. IV. Postbaccalaureate plans of the class of 1978



following: When compared with physics, astronomy attracts a larger proportion of women, and a considerably larger fraction of the astronomy undergraduates (three-quarter), are enrolled at PhD-granting institutions than physics undergraduates (half). The postbaccalaureate plans for astronomy and physics bachelors are quite similar for the class of 1978. Regarding changes during the past four years it appears that graduate study in astronomy declined as employment plans increased; the numbers in both groups are rather small.

Table XII. Use of astronomy education by type of employer for astronomy bachelors, 1978

Type of employer		Use of astronomy education: Extensive	Little	None	Total: N	%
College or university		2	-	-	2	6%
High school		-	1	1	2	6
Industry		7	7	5	19	56
Government		3	4	2	8	23
Other		1	-	2	3	9
Total	N	12	12	10	34	
	%	35%	35%	30%		100%

The flow diagram of Figure IV elaborates on the post-baccalaureate plans presented in Table XI. It shows an increase in astronomy bachelors who enter physics graduate study, a decrease in those who report an unsuccessful search for employment at the time the survey was conducted, and a smaller percentage of graduates with no immediate plans.

In answer to where employment-oriented astronomy bachelors work and what use they make of their training, Table XII lists four types of employers and reports the graduates' evaluations of them.

Industry continues to be the largest employer, and seven out of the nineteen graduates who accepted industrial positions believe they are making extensive use of their astronomy training.